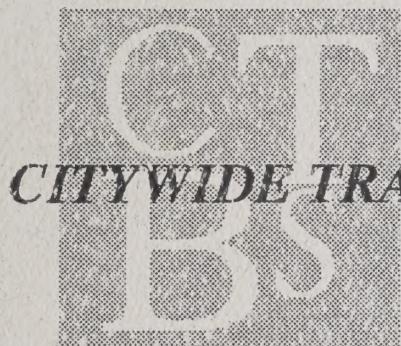


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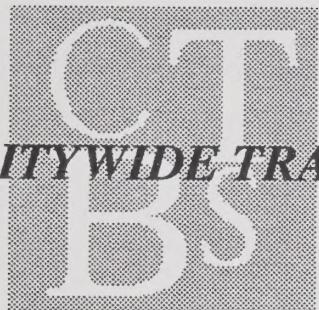
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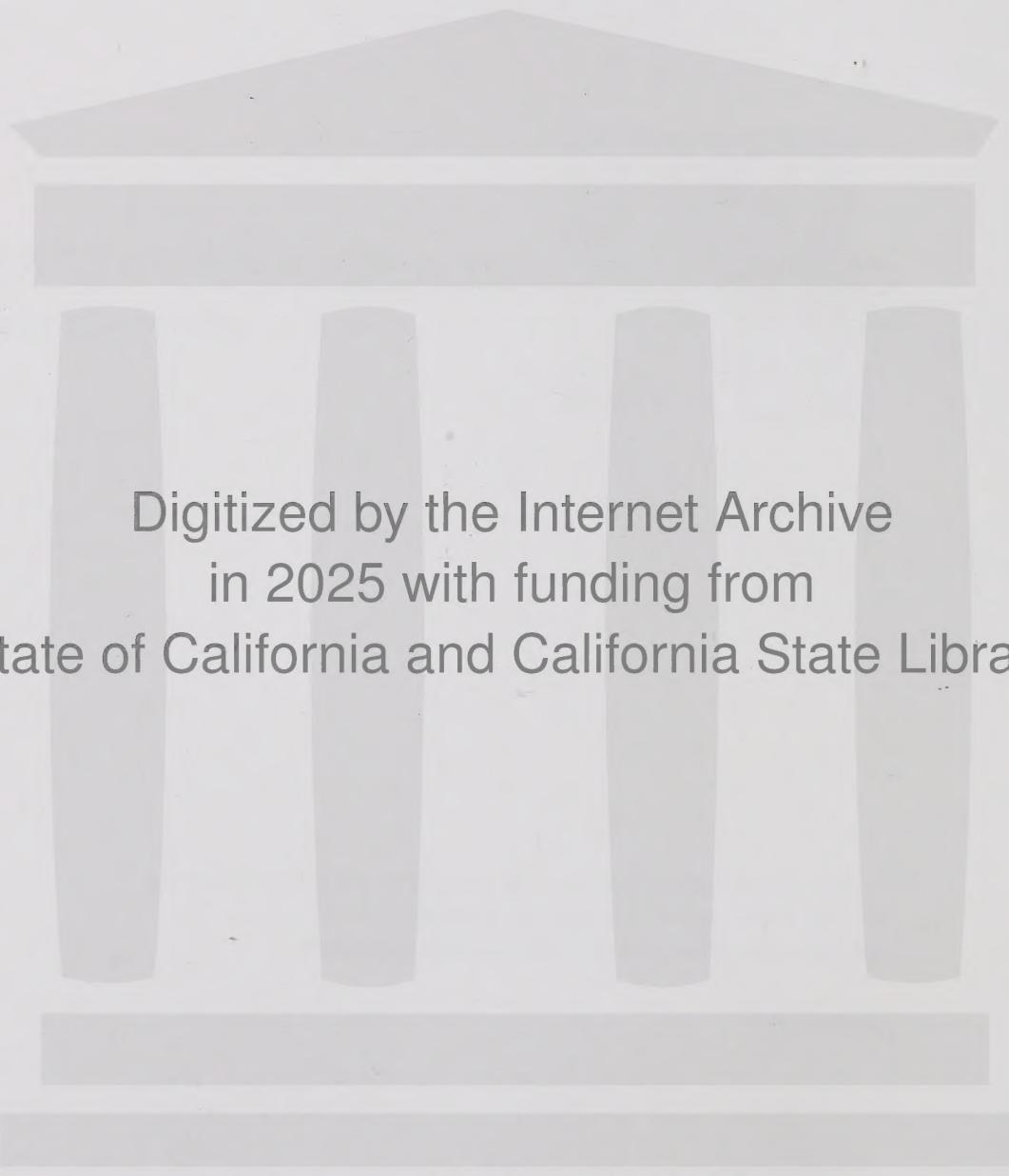
August 1993



CITYWIDE TRAVEL BEHAVIOR SURVEY
PUC/MUNI Data

*A Joint Project of the San Francisco Department of City Planning,
the San Francisco Public Utilities Commission and
the San Francisco County Transportation Authority*

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INTRODUCTION

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This report was prepared by the San Francisco Department of City Planning (DCP) for the San Francisco Public Utilities Commission (PUC) in August 1993. It complements the two reports prepared by DCP as part of the Citywide Travel Behavior Survey (CTBS), conducted during 1992. The first report documents the results of the Employee and Employer Surveys, and the second documents the results of the Visitor Survey. Both reports also contain detailed discussions of survey methodology, analysis and limitations that will not be repeated here.

This report contains summaries of data from the first two reports and additional details of interest to PUC/MUNI. CTBS data are detailed below in three parts: trip rates by land use, MUNI transfer and payment data, and MUNI interoperator data. Each part contains a brief analysis of the relevant data and a discussion of data validity (errors, uncertainties, biases, etc.) where appropriate.

All travel behavior data are given for people using MUNI for the bulk of their travels, except for the aggregate data in sections IA through IC and IID. Survey results have a margin of error of 4% or less at a 95% confidence level, except where noted. Results are disaggregated functionally by land use and geographically by Superdistrict, a unit created by the Metropolitan Transportation Commission (MTC) that divides San Francisco into quadrants. Superdistrict 1 includes the northeast portion of the city and is referred to here as downtown. The boundaries of Superdistrict 1 do not correspond precisely to the boundaries established by the downtown Transit Impact Development Fee (TIDF). However, well over 80% of office employment in Superdistrict 1 is concentrated within the TIDF boundaries, so one can treat the boundaries interchangeably with a reasonable degree of confidence.

I. TRIP RATES BY LAND USE

A. EMPLOYEE DENSITY FOR EACH LAND USE BY SD1 & REST OF SF

Table IA below compares employee counts to the employer square footages reported in the Employer Survey. The Employer Survey asked respondents to specify both the occupied facility area and the number of on-site workers, allowing square feet per worker in that establishment to be calculated directly (second column). By dividing the results into 1000, the more customary measure of employee density can be derived (third column).

Table IA. Employee density by land use.

	SQ FT/WORKER	WORKERS/1000 SQ FT
CITYWIDE		
Office	385.69	2.59
Retail	867.65	1.15
Manufacturing	442.20	2.26
Cultural	437.23	2.29
All Uses	654.20	1.53
SUPERDISTRICT 1		
Office	379.40	2.64
Retail	1289.97	0.78
Manufacturing	383.56	2.61
Cultural	330.73	3.02
All Uses	499.64	2.00
REST OF CITY		
Office	440.48	2.27
Retail	606.10	1.65
Manufacturing	1768.41	0.57
Cultural	464.33	2.15
All Uses	860.58	1.16

The downtown-office figure of 379 square feet per worker differs significantly from the figure of 276 square feet per worker found in background studies for the Downtown Plan and subsequent trip generation studies. Changes in office land use and the commercial real estate market during the past ten years are consistent with this observed change, however. Softening office demand (relative to the enlarged supply) appears to have allowed remaining tenants to afford larger areas and to provide for expansion. Office land use patterns may have changed downtown as well.

B. EMPLOYEE DAILY TRIP RATES FOR EACH LAND USE BY SD1 & REST OF SF

Table IB below combines the employee densities given above (in Table IA) with the per-employee trip generation rate from the Employee Survey to yield average employee daily trip rates per thousand square feet of space. Each employee is assumed to generate two commute trips per day (one trip to work and another one from work) in addition to a variety of noncommute travel during the workday.

Table IB. Employee daily and noncommute trip rates by land use.

	DAILY TRIPS/1000 SQ FT	NONCOMMUTE TRIPS/1000 SQ FT
CITYWIDE		
Office	8.56	3.38
Retail	5.76	3.46
Manufacturing	6.54	2.02
Cultural	8.21	3.63
All Uses	6.16	3.10
SUPERDISTRICT 1		
Office	8.65	3.37
Retail	5.57	4.01
Manufacturing	7.56	2.34
Cultural	9.85	3.81
All Uses	7.39	3.39
REST OF CITY		
Office	8.10	3.56
Retail	6.15	2.85
Manufacturing	3.13	1.99
Cultural	7.88	3.58
All Uses	4.95	2.63

The trip generation rates in the second column include all travel during the workday, including the commute to work and the commute from work. Results in the third column include all travel except for commute trips. The downtown-office rate from the Employee Survey (8.65 trips per 1000 square feet per day) closely matches the rate from the Visitor Survey (9 trips per 1000 square feet per day).

C. DAILY & PEAK HOUR TRIP RATES FOR WORKERS, VISITORS, & TOTAL PER 1000 SQUARE FEET OF SPACE

Table IC below shows daily and peak hour trip rates for workers and visitors, as found by the Visitor Survey. Data for the Peak Season study are not shown, while data for office uses outside Superdistrict 1 were not collected during the Visitor Survey.

Table IC. Daily and peak hour trip rates by land use for workers and visitors.

	DAILY TRIP RATE PER 1000 SQ FT	PEAK HOUR TRIP RATE PER 1000 SQ FT
CITYWIDE		
Office	N/A	N/A
Retail	360	37
Supermarket	360	28
Cultural	281	27
Institutional	98	10
SUPERDISTRICT 1		
Office	18	2
Retail	466	48
Supermarket	893	70
Cultural	304	29
Institutional	103	10
REST OF CITY		
Office	N/A	N/A
Retail	248	25
Supermarket	297	23
Cultural	259	24
Institutional	98	9

Downtown office workers generate 9 trips daily per thousand square feet. Downtown office visitors likewise generate 9 trips daily per thousand square feet. Therefore, the total daily office trip rate is 18

trips per thousand square feet per day, which is identical to the findings of prior surveys. (These figures apply only to office space in Superdistrict 1. Data were not collected for office space in Superdistricts 2, 3 and 4.) Downtown peak hour trip rates for both office workers and visitors were observed to be 2 trips per thousand square feet per hour, which is consistent with the rate used in DCP's environmental review guidelines.

D. PEAK AM & PM USE PERIODS OF MUNI BY SD1 OFFICE EMPLOYEES

For downtown office workers using MUNI, the peak 30-minute periods are 7:50 - 8:20 AM for the morning commute and 5:00 - 5:30 PM for the evening commute. Mean arrival time is 7:51 AM and mean departure time is 5:08 PM for peak-period commute travel. Median arrival time is 8:06 AM and median departure time is 5:00 PM for peak-period commute travel. Distributions of arrival and departure times are summarized in the tables below. These times represent arrivals and departures at work sites, not coach boardings, so they do not measure peak MUNI load times directly because of walking times and other factors.

Table ID1. Distribution of arrival times to work for MUNI riders.

Arrival Time	Office Workers Superdistrict 1 (%)	All Workers Citywide (%)
5:59 AM or earlier	1.5	1.6
6:00 - 6:29	3.0	2.6
6:30 - 6:59	2.8	2.9
7:00 - 7:29	9.0	7.5
7:30 - 7:59	21.4	18.0
8:00 - 8:29	29.9	26.0
8:30 - 8:59	19.7	19.0
9:00 - 9:29	8.4	11.2
9:30 AM or later	4.3	11.2
Total	100.0	100.0

Table ID2. Distribution of departure times from work for MUNI riders.

Departure Time	Office Workers Superdistrict 1 (%)	All Workers Citywide (%)
2:59 PM or earlier	4.7	4.3
3:00 - 3:29	2.1	1.8
3:30 - 3:59	2.3	2.7
4:00 - 4:29	9.2	8.6
4:30 - 4:59	12.2	13.1
5:00 - 5:29	30.9	28.3
5:30 - 5:59	17.3	17.0
6:00 - 6:29	13.2	13.0
6:30 PM or later	8.1	11.2
Total	100.0	100.0

For office workers, 92.0% of downtown arrivals occur during the peak period of 6:30 - 9:30 AM. Similarly, 88.4% of those departures occur during the peak period of 3:50 - 6:30 PM. Results are similar for downtown office workers and all workers citywide, however, arrival and departure times are more widely distributed in the latter case.

E. TOTAL TIDF TRIP GENERATION RATE ON MUNI

Following the methodology supplied by Barton-Aschman Associates in their 1983 TIDF trip generation study, the total TIDF trip generation rates for downtown office workers can be derived.

(1) Employee work trips

Combine morning and evening peak percentages = $(0.920 + 0.884) = 1.804$

Proportion of workdays at work = $(260 - 33) / 260 = 0.8731$

MUNI mode split = 0.585

Worker density = 379 square feet per worker

Number of scheduled weekdays of MUNI service = 256 days

Employee TIDF trip rate = $1.804 \times 0.8731 \times 0.585 / 379 \times 256 = 0.622$

(2) Employee non-work trips

Nonwork trip rate = 3.37 trips per 1000 square feet

Proportion of nonwork trips during peak period = 0.11

MUNI mode split = 0.11

Worker density = 379 square feet per worker

Number of scheduled weekdays of MUNI service = 256 days

Visitor TIDF trip rate = $3.37 \times 0.11 \times 0.11 / 379 \times 256 = 0.028$

(3) Overall trip rate

$$\text{TIDF trip rate} = 0.622 + 0.028 = 0.65 \text{ trips per square foot per year}$$

Some factors used in the equations have changed as a consequence of the CTBS, most notably density and mode split. (Factors that have changed are shown above in a bold typeface.) However, the overall TIDF trip rate has not changed significantly from 0.64 trips per square foot per year.

II. MUNI TRANSFER & PAYMENT DATA

A. AVERAGE DAILY MUNI TRANSFER RATE FOR OFFICE WORKERS

The tables below include all workers who use MUNI for the bulk of their commutes to and from work. One way of evaluating transfer rates is by calculating the mean number of transfers per passenger trip.

Table IIA1. Transfer rates for MUNI riders.

	Transfer Rate To Work	Transfer Rate From Work
All Workers	0.92	0.94
Office Workers/Citywide	0.62	0.64
Office Workers/Superdistrict 1	0.60	0.63

Another way of describing transfer rates is to calculate the extent of transfer use, that is, the proportion of ridership by the number of transfers made per trip. The following table applies equally to commute trips to and from work.

Table IIA2. Number of transfers made by MUNI riders.

	Transfers: 0 (%)	1 (%)	2 (%)	≥ 3 (%)
All Workers	40.3	37.7	18.1	3.9
Office Workers/Citywide	55.3	35.2	8.3	1.2
Office Workers/Superdistrict 1	57.7	35.2	6.0	1.1

Still another way of describing transfer patterns is to derive the ratio of unlinked trips to linked trips. An unlinked trip is any segment of a trip. A linked trip is the total of all trip segments considered as a single trip. Thus, a trip with no transfers can be considered one unlinked trip and one linked trip; a trip with one transfer can be considered two unlinked trips and one linked trip; and so forth. Recalculating Table IIA2 to incorporate these definitions yields Table IIA3 below.

Table IIA3. Unlinked and linked trips made by MUNI riders.

	U/L Ratio
All Workers	1.86
Office Workers/Citywide	1.55
Office Workers/Superdistrict 1	1.51

The U/L ratio used in the 1987 TIDF cost certification report is 1.39, derived from a ridership survey in 1980. By contrast, the current study reports a ratio of 1.51 for downtown office workers. This change may reflect the realignment of MUNI service in the early 1980's to provide enhanced and more direct service downtown, and/or changes in MUNI transfer policies.

B. AVERAGE LENGTH OF TIME FOR MUNI COMMUTE TRIPS

The values in the table below are mean travel times for MUNI riders.

Table IIB. Average commute times for MUNI riders.

	To Work (minutes)	From Work (minutes)
All Workers/Citywide	38	47
Office Workers/Citywide	37	46
Office Workers/Superdistrict 1	37	46

For all workers, the median travel times to work are 40 minutes in the morning and 45 minutes in the evening. For office workers inside and outside downtown, the median travel times are 45 minutes in the morning and 55 minutes in the evening. Not all of this time is spent on MUNI; these overall travel times may reflect walking at either end of the trip, waiting for transfer coaches, etc.

C. METHODS OF MUNI PAYMENT FOR EACH LAND USE BY SD1 & REST OF SF

Table IIC below lists percentages by payment method for each land use category.

Table IIC. Methods of MUNI payment by land use.

	Cash (%)	Fast Pass (%)	BART+ Pass (%)	Other (%)	Total (%)
CITYWIDE					
Office	28.7	64.0	1.8	5.5	100.0
Retail	48.6	45.3	3.0	3.1	100.0
Manufacturing	33.5	58.1	2.6	5.8	100.0
Cultural	43.5	46.5	6.5	3.5	100.0
All Uses	34.8	57.6	3.0	4.6	100.0
SUPERDISTRICT 1					
Office	28.0	64.8	1.7	5.5	100.0
Retail	42.8	54.6	2.6	0.0	100.0
Manufacturing	28.1	65.5	2.0	4.4	100.0
Cultural	41.7	52.7	2.8	2.8	100.0
All Uses	30.5	62.5	2.1	4.9	100.0
REST OF CITY					
Office	33.9	58.5	2.7	4.9	100.0
Retail	54.5	35.9	3.5	6.1	100.0
Manufacturing	40.9	48.0	3.4	7.7	100.0
Cultural	43.6	46.3	6.5	3.6	100.0
All Uses	44.0	46.9	4.9	4.2	100.0

The proportion of Fast Pass use among downtown office workers is 0.648, in contrast with the 1983 estimate of 0.526. The Fast-Pass/Cash ratio for those riders is 2.3 (i.e., 0.648/0.280). The value of a Fast Pass can be considered to be the number of uses required before the total of those fares exceeds the cost of the pass, i.e., the passenger breakeven point. Between 1987 and 1993, the passenger breakeven point has fluctuated only minimally – from 30.7 fares (\$23.00/\$0.75) to 33.3, 35.3, 32.0, and then 35.0

fares (\$35.00/\$1.00). In decreasing order of frequency, other payment methods include: Peninsula Pass, BART two-way ticket, ferry transfer, and MUNI employee pass.

D. FAST PASS CONSUMPTION

For MUNI riders citywide who use a Fast Pass, the average number of commutes each direction is 4.329 one-way linked commutes per week. The average rate of noncommute travel is 5.396 noncommute trips per week. The Fast Pass use rate therefore is $(4.329 \times 2) + 5.396 = 14.054$ overall trips per week.

III. MUNI INTEROPERATOR DATA

A. AVERAGE MONTHLY USE OF FAST PASS ON BART & BART+ PASS ON MUNI

Table IIIA. Monthly use of Fast Pass and BART+ Pass.

	Fast Pass on BART (Uses per Month)	BART+ Pass on MUNI (Uses per Month)
All Workers	30.3	36.5
Office Workers/Citywide	26.8	36.6
Office Workers/Superdistrict 1	26.8	36.7

The CTBS Employee Survey questions asked respondents who used passes to give their weekly rates of pass use. The resulting weekly rates were then converted to monthly rates. More precisely, they were divided by 5 to get daily rates and then multiplied by 20.1 to get monthly rates. (It was assumed that 20.1 travel days existed per month on average, in accordance with the analysis given in the 1987 TIDF cost certification report as Exhibit B-8.) Thus, the survey responses were multiplied by 4.02 (20.1/5) to yield the numbers in Table IIIA. Values in the table reflect all use, not just peak-period use.

B. AVERAGE DAILY RATE OF EMPLOYEE TRANSFERS TO MUNI FROM REGIONAL TRANSIT OPERATORS

Table IIIB. Transfer rate to MUNI from other regional operators.

OPERATOR	AVERAGE DAILY TRANSFER RATE
AC Transit	0.87
CalTrain	1.29
SamTrans	0.68
BART	0.86
Golden Gate Transit (bus)	0.73
Golden Gate Transit (ferry)	0.77
Harbor Bay Ferry	0.39
Alameda Ferry	0.63
Vallejo Ferry	0.63

The Employee Survey asked this question for the survey week, and the cumulative results were divided by 5 to yield the table above. Responses were grouped strongly around 5 per week and 10 per week, implying that there was some ambiguity in the interpretation of this question as well as wide individual variation in transfer patterns.

C. MUNI TRIPS BY VISITORS LINKED TO OTHER REGIONAL TRANSIT OPERATORS BY SD1 & REST OF SF

In general, visitor trips on MUNI are unlinked. Some are linked to other MUNI trips or linked to walking trips. (The U/L ratio for visitor trips is 3.29 citywide, according to the Visitor Survey.) The only significant interoperator transfer rate is a 3% transfer rate to and from BART; all other rates are negligible.

SUMMARY

The TIDF ordinance calls for regular data collection by DCP and review of the TIDF model by PUC. This report summarizes data which may be used by PUC to recalculate the TIDF formulas, evaluate their continued suitability, or calibrate new transit fees. This report includes trip generation, transfer, payment, and interoperator data from the CTBS.

ACKNOWLEDGEMENT

Mr. Jasper Rubin of the Department of City Planning served as lead analyst for the CTBS project. His efforts were invaluable to the preparation of all CTBS reports and technical memoranda.

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